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AGE OF WOOD -- EXTENDING THE TIMBER RESOURCE.(U)
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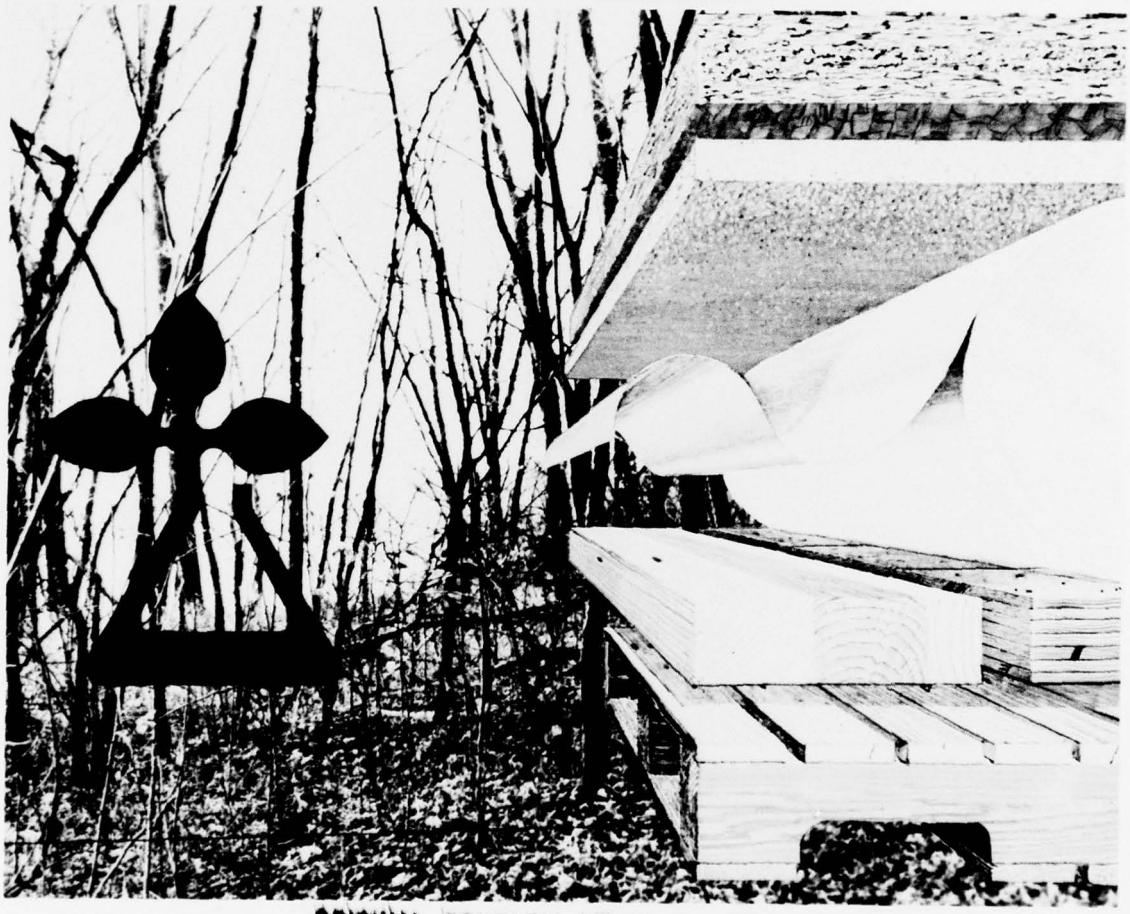
United States
Department of
Agriculture

Forest Service

**Forest
Products
Laboratory**

1979/1980

Age of Wood/ Extending the Timber Resource



ORIGINAL CONTAINS COLOR PLATES: ALL DDC REPRODUCTIONS WILL BE IN BLACK AND WHITE.

Errata
Page 7 Photo
caption should read:
Typical stands:
small diameter soft-
wood (left) and
aspen.

Introduction

Timber supply--for raw materials in manufacturing and for residential and industrial fuels--has been a major concern in virtually all nations, throughout recorded history. In the United States, timber products play a more vital role than is generally appreciated--being produced in larger tonnages than the combined annual output of metals and cement and vastly exceeding production of plastics. Our nation has a large share of the world's forest resource--but we consume an even larger share of the products manufactured from this resource. Thus, the long-term adequacy of wood supplies has been, and remains, a matter of considerable public interest.

Trees are a natural resource that is eminently renewable, expandable and flexible. The extent to which society can take advantage of these attributes is governed, in large degree, by technology. Utilization technology, in particular, influences the effective size of the resource--in relation to national requirements. This report describes some of the most recent findings from research, by the Forest Products Laboratory and cooperating universities, aimed at extending U.S. timber supplies. It emphasizes more efficient use of wood in housing, processing of hardwoods and logging-residue-type materials, increased yield from small sawlogs, and protection of wood from decay. It also explains briefly the general programs of the Laboratory and describes technology transfer efforts.

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General Programs of Research

The scientific staff is organized in nineteen research work units for administrative purposes; but planning is done in terms of 9 major programs as shown below:

	Approximate 1979 Scientist Years
Lumber & Wood Products	19
Adhesives	6
Pulp & Paper	21
Construction & Materials Properties	24
Protection of Wood	10
Energy & Chemicals	11
National Timber Requirements	5
Wood Anatomy	4
Forest Mycology	4
Total	104

Research under the first 3 of these titles is aimed primarily at improvements in processing to allow increased recovery or use of abundant, low-quality trees or residues for industrial products. Construction and Materials Properties and Protection of Wood involve studies to conserve timber-based products in use, through effective engineering and construction and treating practices.

The Energy and Chemicals Program provides basic information on techniques for production of chemicals from wood and bark or from byproduct streams at pulpmills. It also provides information on fuel uses of wood.

National Timber Requirements Research develops information on end uses of wood--including detailed statistics on kinds and quantities of forest products consumed in major markets. The unit also evaluates the effects of trends in economic factors governing timber use.

The Laboratory's Center for Wood Anatomy Research is an international source of information on wood characteristics--advising industry and Government on identification of wood species from all over the world, and on likely performance of these species in various uses.

The FPL Center for Forest Mycology Research is the national reference for identifying forest- and wood-inhabiting fungi and for evaluating their relationship to forest productivity and their basic role in wood products deterioration.

All of these programs are described briefly in "PROSPECTUS '79-'80", available from the Laboratory on request.

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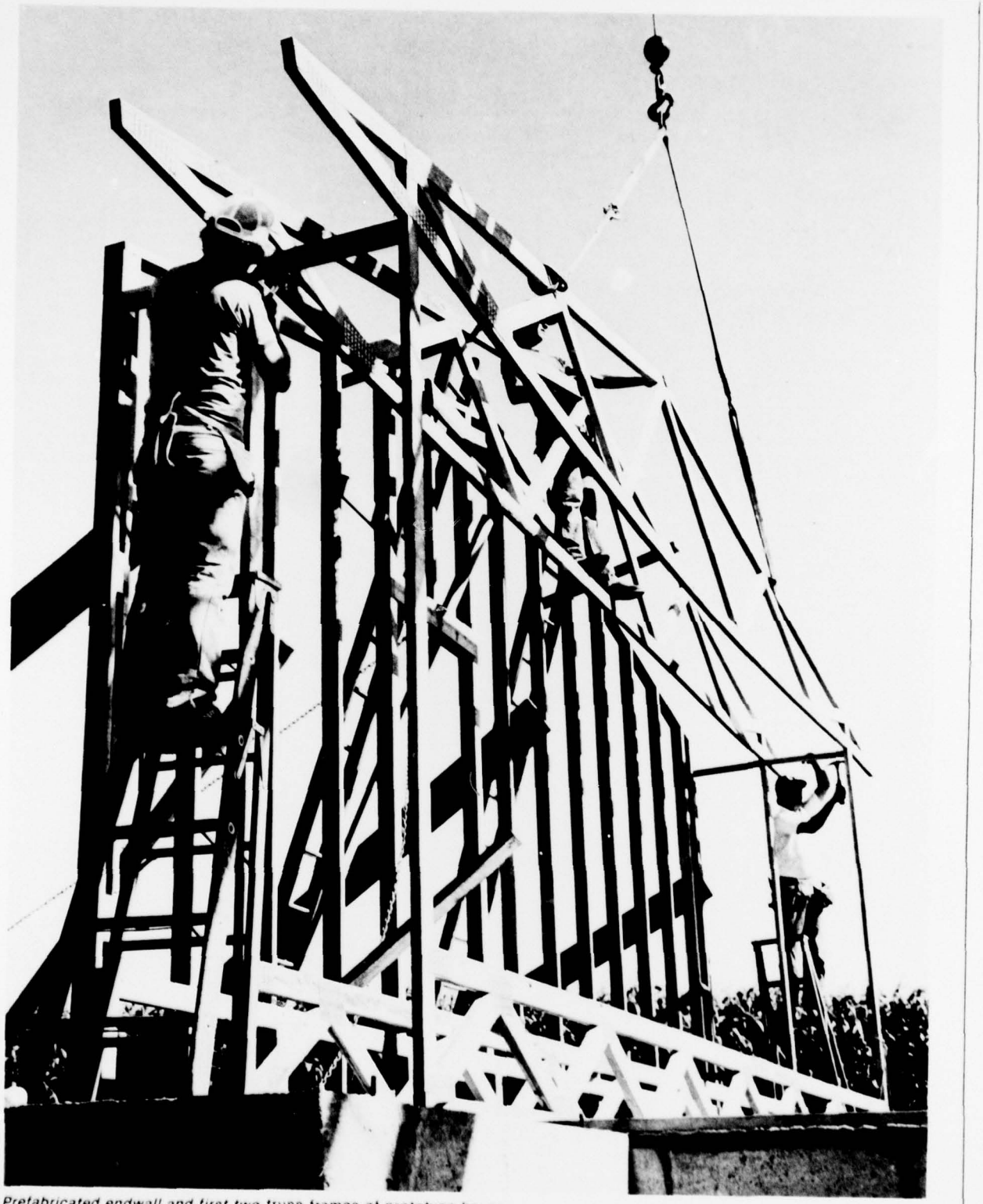
R. L. Youngs

Director



Prefabricated endwall and first two truss frames of prototype house

Lightweight Truss-Framed House

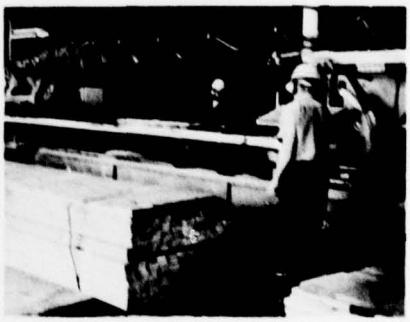
In line with FPL's mission to extend the Nation's timber resource, research in light-framed construction led to the development of a new concept called the lightweight truss-framed house. Designed to use less lumber per square foot of house and to lower construction costs, this new system incorporates a trussed floor system, a trussed roof system and conventional wall studs into a unitized frame. It also allows for energy saving features such as thicker insulation and reduced window area.

To demonstrate this new building system, the Forest Products Laboratory and the University of Wisconsin, Department of Agricultural Engineering collaborated in constructing a prototype three-bedroom ranch style house on one of the University's experimental farms. A three-man crew with a light crane and operator framed the 26- by 48-foot house in only 6 hours. Due to structural improvement provided by this design, the framing units, made only from 2- by 4-inch lumber, were placed 24 inches apart instead of the usual 16 inches.

Based on competitive bids for the truss-framed house and its conventional counterpart, a savings of approximately $2,300 was realized for the truss-framed system. As the system becomes more widely used, such savings can be expected to increase. Invented by Roger L. Tuomi, an engineer at the Forest Products Laboratory, the system is patented under Public Patent No. 4,005,556 and assigned to the people of the United States.

Getting the truss-framed house from concept to reality: 1) Pile of 2-by-4 lumber; 2) Fabricating the floor trusses; 3) Unitized structural truss frames; 4) On-site erection; 5) Partially framed house; 6) Completed house.

1



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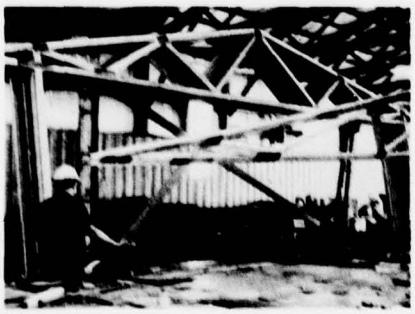

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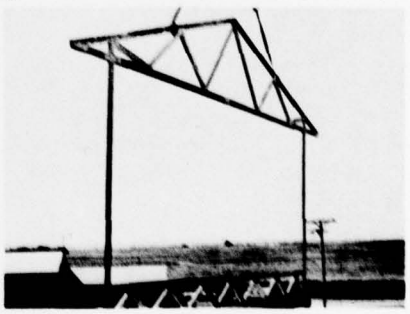

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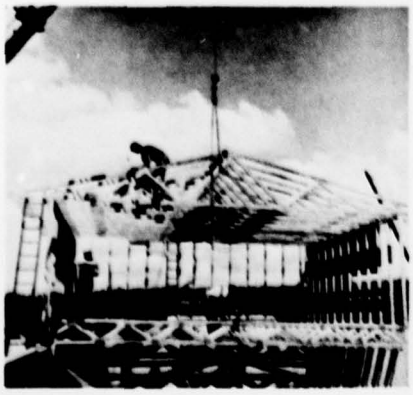

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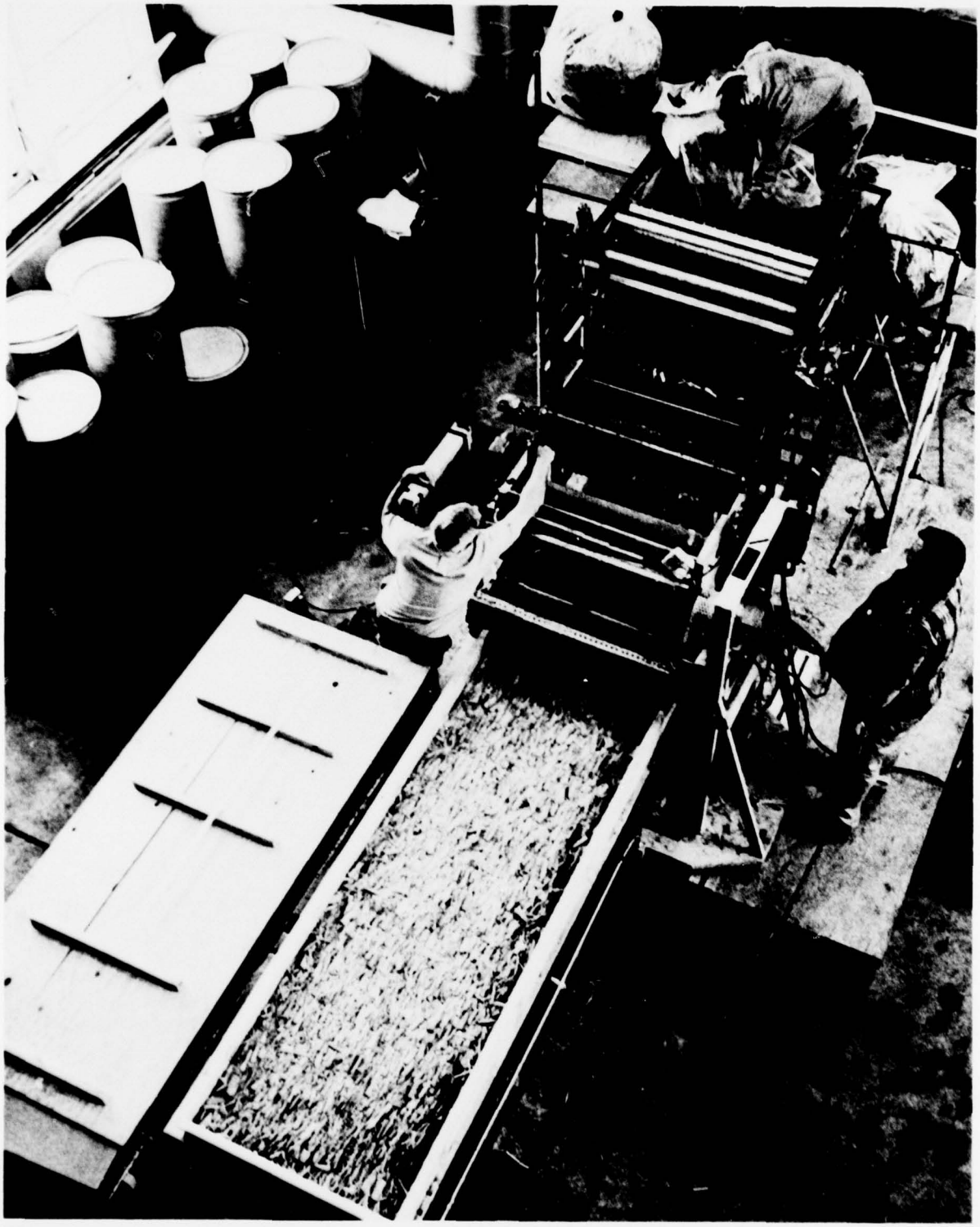


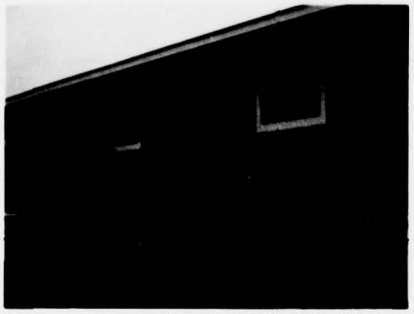
Spreading core chips for 3-layer flakeboard mat

Structural Flakeboard for Walls and Roof Decking

Residues

To achieve better use of the timber resource, the Forest Service developed a structural flakeboard from forest residue that includes timber damaged by insects, disease and fire, logging residues, and precommercial thinnings. Research involving a number of Forest Service units and the National Particleboard Association was carried out in economics and marketing, harvesting, pre-processing, materials and processing. The Forest Products Laboratory fabricated and assessed the performance of 4- by 8-foot panels from Douglas-fir forest residues.

Panels used as wall sheathing exceeded specified acceptance standards for full-size walls. The panels met maximum load and deflection recommendations of the Uniform Building Code for roofs and floors. Under fire exposure, the panels demonstrated a Class B flame spread rating and exceeded the fire endurance requirements for exterior walls of one- and two-family dwellings.



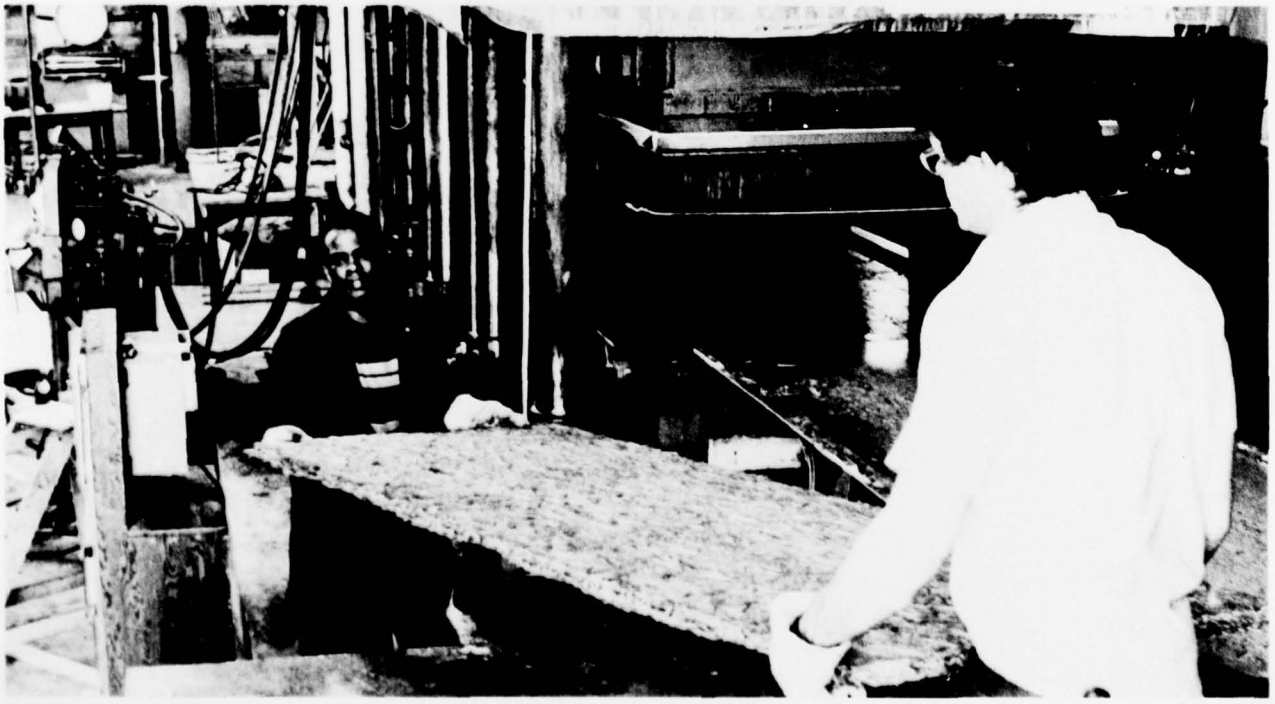
Structural flakeboard on exterior of house.

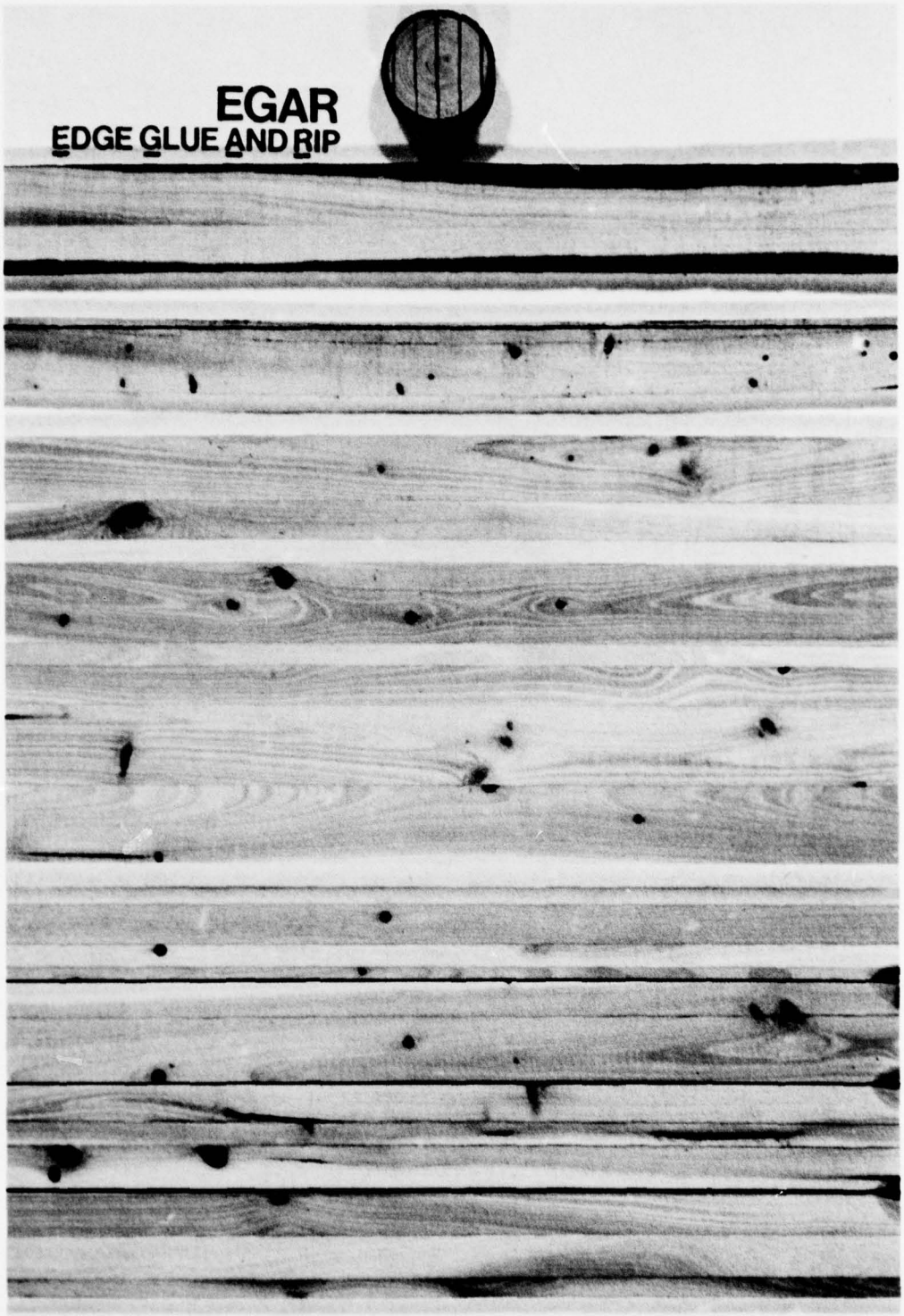
Hardwood

The residual limbs and branches in tops of merchantable hardwood trees and entire low-quality, small-diameter hardwood trees can provide the wood resource for a structural flakeboard suitable for roof decking in industrial and commercial buildings.

Laboratory tests, made in cooperation with Purdue University scientists, indicate that commercial flakeboard roof decking could meet the engineering requirements for roof decking, economically. In addition, it would have a better thermal insulation value than some alternative roof decking materials.

Removing finished flakeboard panel from the press.





The EGAR process (top to bottom) full-width dried boards; squared-up edges; glued edgewise into panels; ripped to desired widths.

Yield from Small Logs

Although the national volume of timber shows a continuing increase, a great proportion of the gain is in the growth of small diameter trees. To allow greater use of these small-diameter trees and extend the yields from our forests, new technology has paved the way to increased lumber recovery by reducing errors in sawing decisions. It also permits the production of lumber wider than the log from which it is sawed.

The Best Opening Face (BOF) program can improve yield from small logs by 10 percent or more. The Edge Glue and Rip (EGAR) process can add an additional 10 percent to yield and make possible the production of wide dimension lumber from small logs.

BOF employs log scanners, computer made sawing decisions, and high precision computer controlled setworks to improve log yields. EGAR uses BOF to produce flitches that are dried full width. Edges are squared up and the boards are glued together edge-wise, using waterproof glue to form wide, flat panels, which are then ripped into lumber of desired widths.

Industry has attained yield increases of 10 to 15 percent by using BOF. EGAR makes possible an additional 10 percent in yield; also lumber of any width can be produced from small trees. A mill owner could expect a higher rate-of-return on investment and greater wood utilization from a BOF and/or EGAR mill than from a conventional mill of the same size.

Hardwood Construction Lumber

Low and medium density hardwoods provide a good potential resource for structural dimension lumber. A substantial surplus of growth over drain has been reported throughout the hardwood range. The supply of pole and small sawlog size trees greatly exceeds demand. Species having potential include yellow-poplar, aspen, gums, cottonwood, soft-maple, willow, sycamore and, on the west coast, red alder. In small diameter trees, knots are generally small and tight in the lumber. The species mentioned have good nailing qualities and resist splitting.

Recent attempts to make studs from several of the named species failed because the studs warped in excess of grading standards and could not be manufactured economically. Researchers at the Forest Products Laboratory have virtually eliminated the problem in yellow-poplar and have greatly reduced it in aspen. Other species have received only incidental testing to date. The quality of studs was achieved by live sawing logs into flitches, drying the flitches, and then sawing the studs from the flitches. More than 99 percent of all yellow-poplar studs met warp requirements for STUD grade, and over 95 percent of aspen studs met the requirements.

The SDR Concept (Saw, Dry, and Rip) may provide a viable and economic alternative for utilizing the surplus low and medium density hardwoods. The utilization of this resource can result in better forest management, lower energy requirements due to reduced transportation to eastern markets, and some relief for the softwood timber resource.

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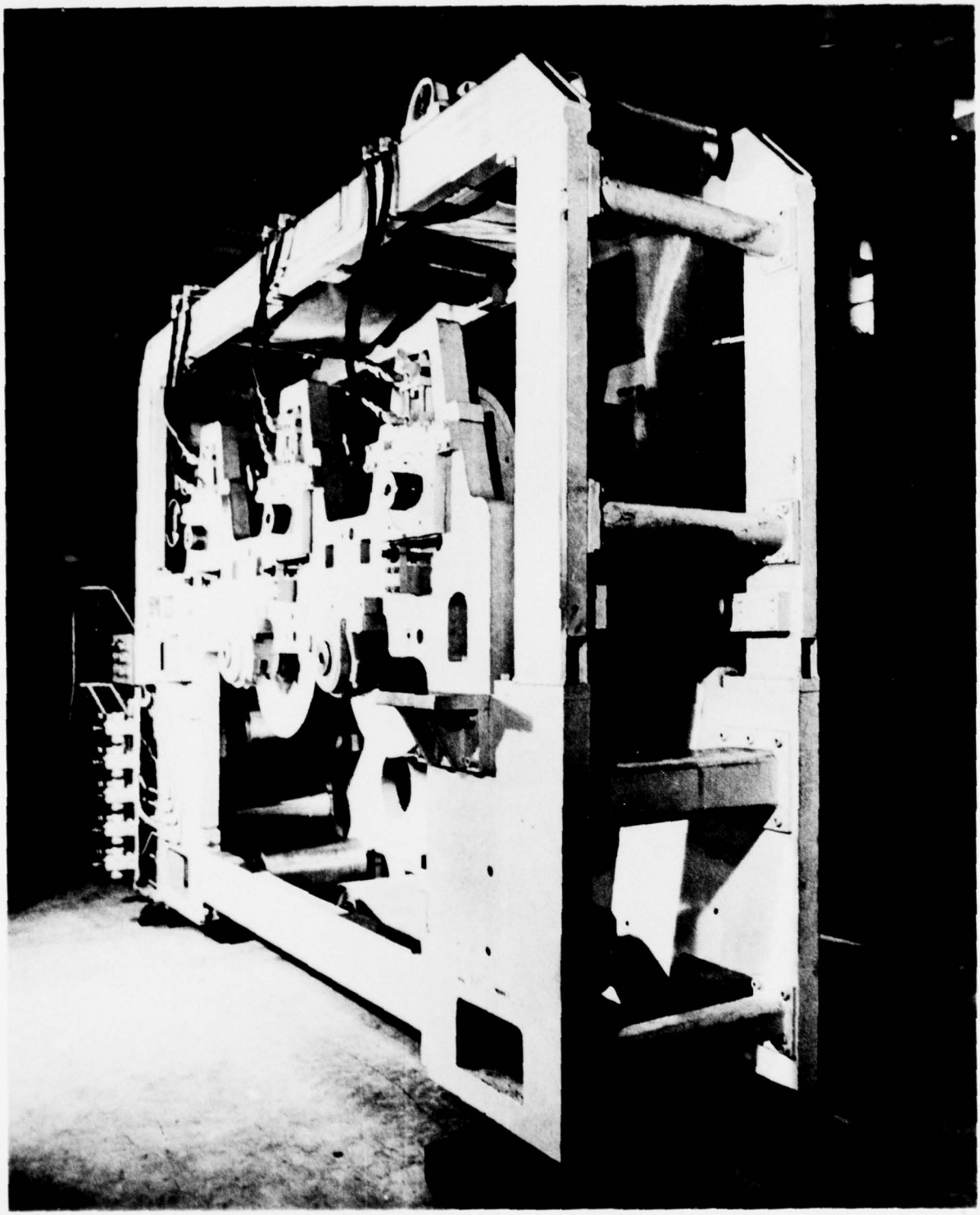
Typical stands: small diameter softwood (left) and yellow-poplar.



Press driving equipment for FPL experimental paper machine ... speed, temperature, and pressure are stressed in new system

Pulp and Paper

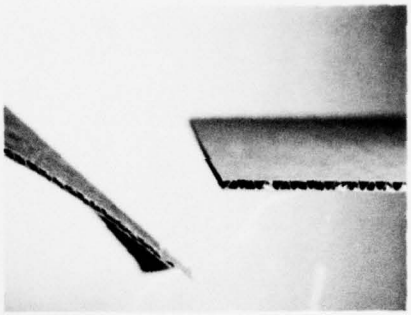
Woodpulp consumes about one-half of the wood fiber processed in the United States annually and its demand is expected to rise substantially in the next 10-20 years. Currently, softwoods are preferred because fibers from hardwoods are too stiff and short, adversely affecting the paper-making efficiency and quality of the final product. This is particularly true in packaging papers and linerboard which make up 25 percent of the U.S. pulp and paper production.

Three FPL research projects aimed at increasing the proportion of hardwoods in pulp and paper manufacture are press-drying, SOFORM process, and chemimechanical pulping.

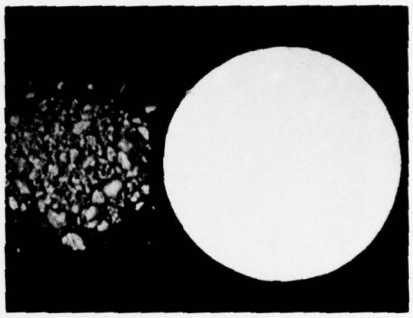
Press-drying, a new process for drying a mat of wet fibers to form paper, shows promise for making high strength paperboard from high yield hardwood pulp. When put into commercial use this process should greatly increase the market opportunity for underutilized hardwoods. It should also significantly reduce the energy required for the manufacture of paperboard.

SOFORM process is a treatment of paper and paperboard with gaseous formaldehyde and sulfur dioxide. It introduces chemical crosslinks in the fiber cell walls, reducing its natural sensitivity to water. When fully water soaked, a SOFORM treated fiber product retains over 70% of its dry stiffness. Since fiber products currently are overdesigned to compensate for the loss in strength when the material becomes wet, SOFORM process will permit a reduction in fiber content of the paper and paperboard. This will result in an extension of U.S. fiber resources.

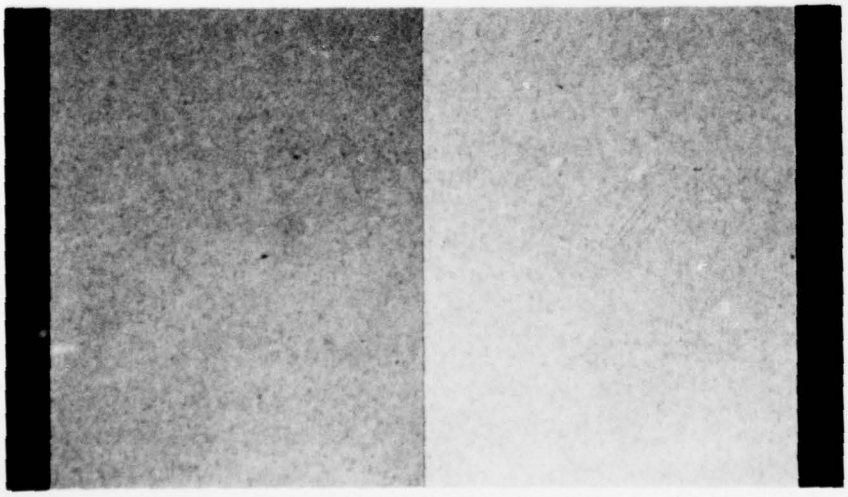
The chemimechanical process is particularly suitable for making high-yield pulps from high-density hardwoods. This process, which retains nearly all of the wood lignins, produces pulp yields in the 80 to 90 percent range compared to those of 40 to 50 percent of most processes and requires less energy. Research is under way to improve the color, strength, and drainage characteristics of pulp used for a variety of packaging and printing papers.



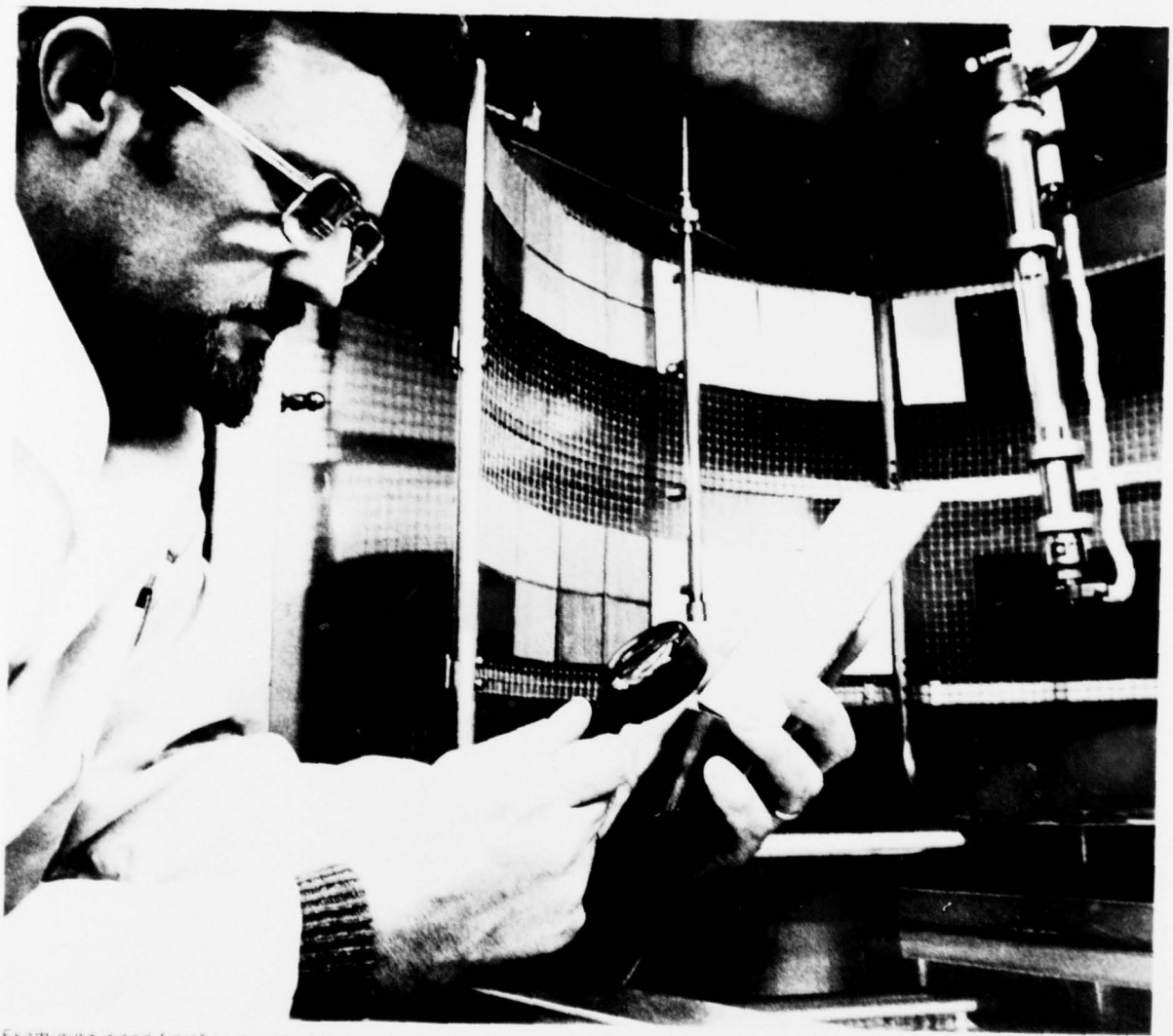
Conventional (left) and SOFORM-treated paperboard after several hours in water



Pulp and handsheet from chemimechanical process



Paperboard samples: conventional (left) and press-dried linerboard.



Examining wood finishes exposed in accelerated weathering apparatus

Painting and Finishing Wood

Wood used on the outside of houses and other structures can be painted, stained or left to weather naturally. In the absence of decay, it will weather to a gray surface providing its own natural finish. The unprotected wood surface will slowly wear away at a rate of approximately ¼ inch per century.

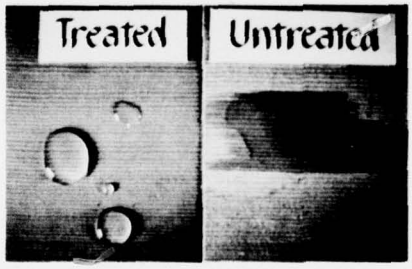
Paints and Stains

Wood, however, can be protected by paints and stains, and when properly applied an exterior finish may last 10 years on wood materials with good paint-holding characteristics.

A growing trend exists today toward finishing wood on the outside of homes and other structures that results in a "natural look." A semitransparent, penetrating stain finish developed through FPL research is an excellent, durable "natural" finish, particularly for rough textured wood surfaces. The first application may provide protection for 2 to 4 years but reapplication to weathered surfaces results in a finish that could last for 8 years or more.

Water-Repellent Preservatives

Research at the Forest Products Laboratory has shown that water-repellent preservatives (WRP), using simple wax based ingredients, result in "natural" wood finishes that retain original look and color of wood siding. They can be easily applied to wood surfaces and provide protection against weathering and against the unsightly growth of mildew. The initial WRP treatment may last 1 to 3 years depending on the severity of exposure, but longer lifetimes up to 4 years result when the siding is refinished.



Wood finishes: paint (top); FPL natural stain; and water-repellent preservative.

OTHER LABORATORY ACTIVITIES AND SERVICES ...

Technology Transfer

Reliable, scientifically proven information is the chief product emanating from research conducted at the Forest Products Laboratory. Interpreting such information, packaging it for various media, and distributing it through effective communications techniques combine to achieve technology transfer to an inquiring public. Requests come from many sectors of the public: homeowners, builders, code authorities, scientists, many public and private institutions, and others -- not only in the United States but from countries throughout the world.

To be responsive to the many interest groups comprising this broad public and at the same time promote greater use of research results, the Laboratory's information program is directed through a wide range of media that include the following:

Conferences & Workshops such as:

- The Annual Forest Products Utilization Research Conference
- The Conference on Utilization of Tropical Forests (1978)
- The Clark C. Heritage Workshop
- The Annual Industry Liaison Meeting

Research Agreements, with:

- Universities
- Institutes
- Firms and Industry Associations
- Government Agencies
- Individuals

Liaison meetings with industry leaders...

Publications and Papers comprised of:

- Technical and Scientific
- Semitechnical and Special
- Popular and Instructional

Special Brochures, dealing with:

- Program activities
- Personnel and organization
- Aids to forest products utilization

News Releases and Features on:

- Research findings and accomplishments
- Items of consumer interest

Patents, such as those covering:

- Truss-frame house
- Combination sheathing support member building product
- Treatment of wood with butylene oxide

technical exhibits for practitioners...

...general public tours

Tours and Contacts

- FPL staff hosted over 11,000 visitors and responded to over 60,000 telephone calls and letters, and
- Prepared 116 special tours for groups with educational, professional and general interests.

FOR MORE INFORMATION, Write:

The Forest Products Laboratory
Forest Service
U.S. Department of Agriculture
P.O. Box 5130
Madison, WI 53705

or phone:
(608)264-5600

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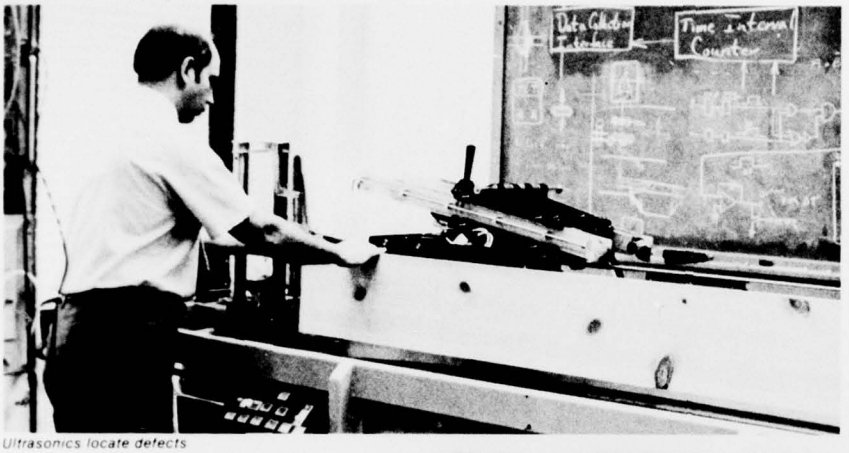
If you feel you have been denied the benefits of any USDA program on any of these grounds, write directly to the Secretary of Agriculture, Washington, DC 20250.

Tests simulate shipping effects

Continuing research on wood utilization leads to broad economic and social benefits.



Ultrasonics locate defects

Maintaining reference culture collection

Identifying wood species

Converting wood to chemicals

Testing laminated beams

Checking hardboard thickness